Supplementary Data

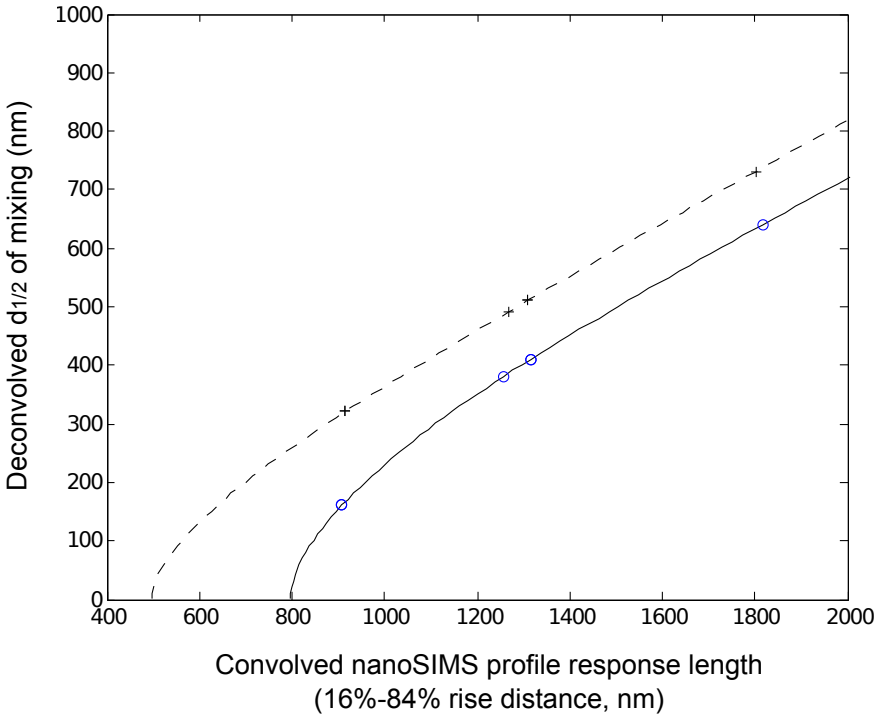

Figure 1: Calibration curve of response length ($l_{1/2}$) on the x-axis vs. mixing half-distance ($d_{1/2}$) on the y-axis from modeled NanoSIMS profiles, assuming an 800 nm spot size (solid line), and a less likely 500 nm spot size (dashed line), as described in the methods section. Measured response lengths ($l_{1/2}$) for each profile are plotted on the curves (circles and crosses).

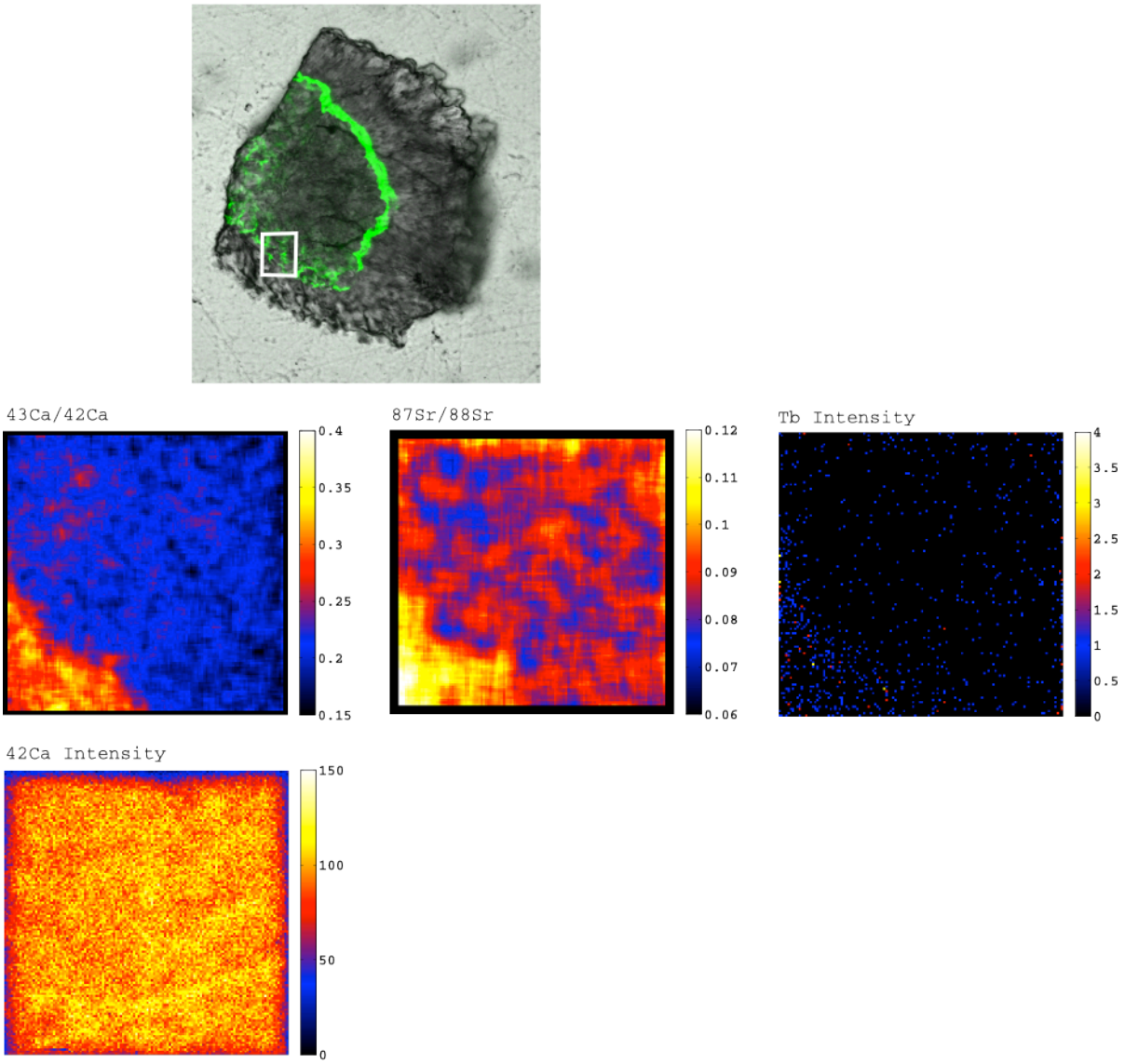

Figure 2: NanoSIMS ion image of the boundary between the initial skeleton and new growth in Coral 10(3)/7, Mount AB, Spine 0C, Image 4. White box shows location of ion image in relation to the calcein mark. This spine is roughly 130 μm long by 150 μm wide. Due to geometrical limitations ion counting detectors can be positioned to either collect 88Sr and 136Ba or alternatively Tb, but not both. In this and the following two images, Tb was collected.

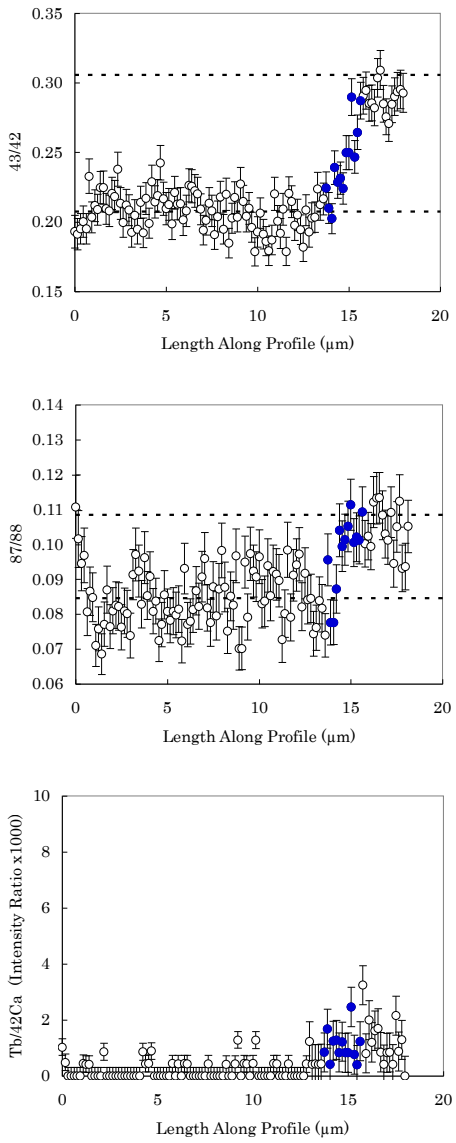

Figure 3: Profiles of the enriched isotopes ^{43}Ca, ^{87}Sr and ^{159}Tb across the new growth boundary in Coral 10(3)/7, Mount AB, Spine 0C, Image 4 (the previous image). The points corresponding to the 43/42 transition region are marked in blue. These same blue points also fall within the transition of 87/88 from natural to enriched abundance and correspond to the rise in ^{159}Tb above the detection limit. Dashed lines mark natural and spike isotope ratios from ICP-MS measurements of the culture solution. The 16%–84% width of the boundary in the 42/43 profile is 1.8 μm. Profile step size is $\sim$150 nm. Error bars are 1σ from counting statistics.

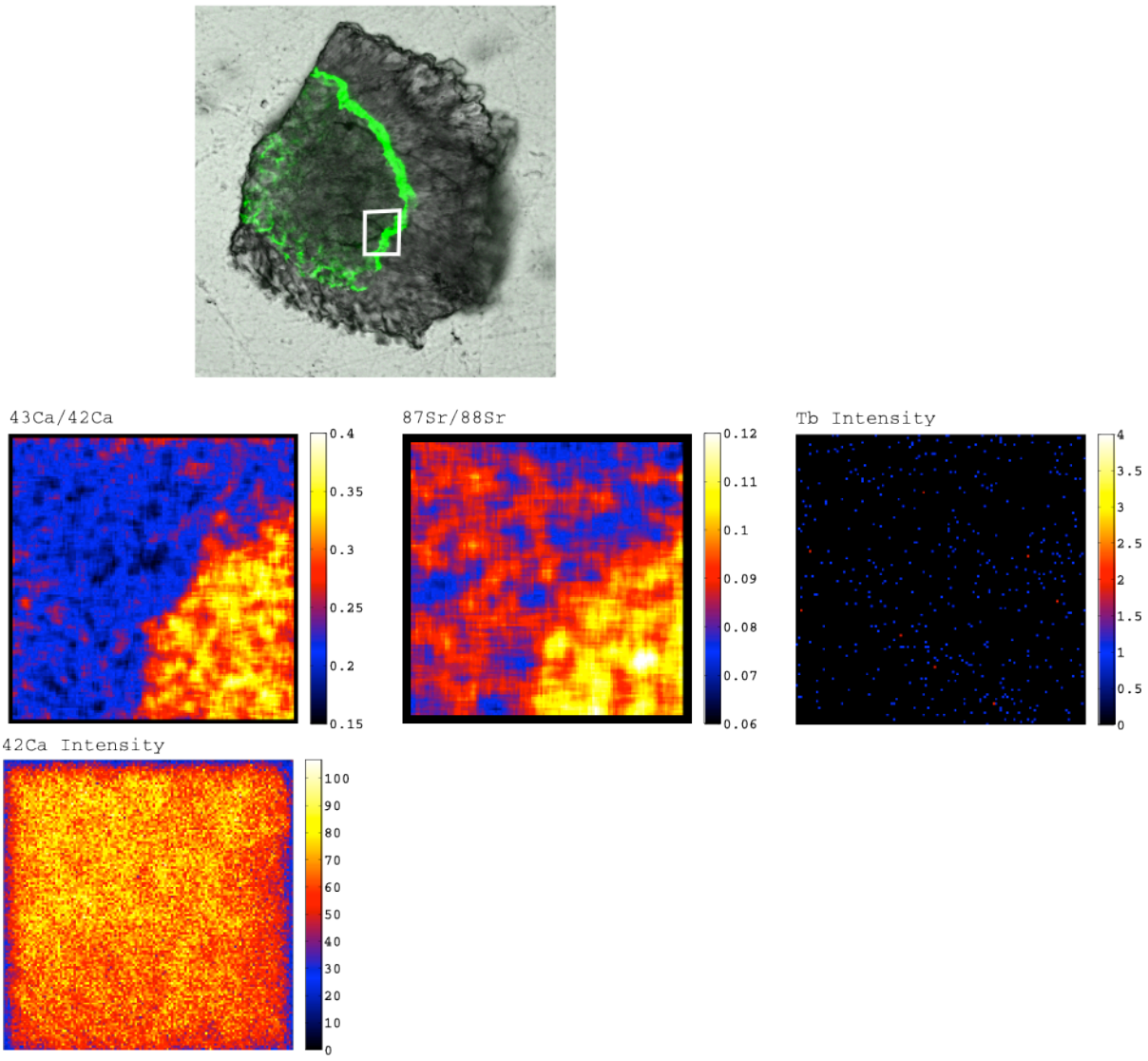

Figure 4: NanoSIMS ion image of the boundary between initial skeleton and new growth in Coral 10(3)/7, Mount AB, Spine 0C, Image 6. Spine is roughly 130 μm long by 150 μm wide. Unusually low Tb sensitivity for this particular ion image likely obscures the presence or absence of any difference in Tb across the boundary.

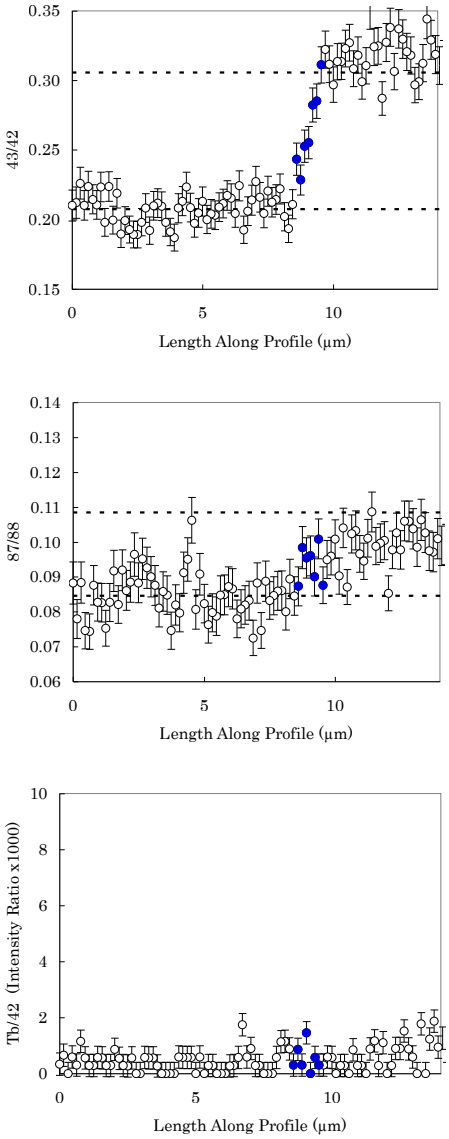

Figure 5: Profiles of the enriched isotopes ^{43}Ca, ^{87}Sr and ^{159}Tb across the new growth boundary in Coral 10(3)/7, Mount AB, Spine 0C, Image 6 (the previous image). Low Tb sensitivity for this particular ion image likely obscures the presence or absence of any difference in Tb across the boundary. The 16%–84% width of the boundary in the 42/43 profile is 0.9 μm.

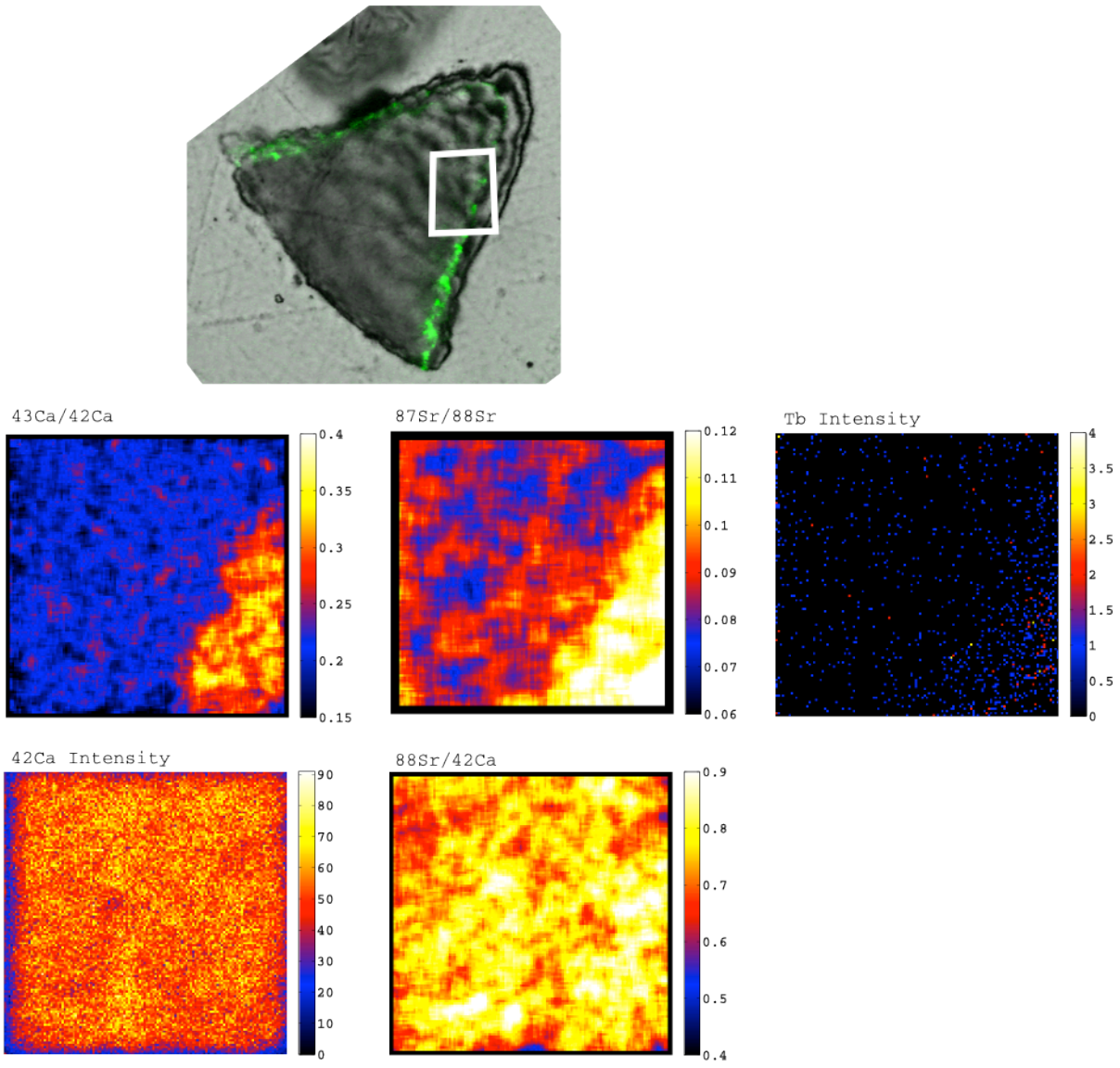

Figure 6: NanoSIMS ion image of the boundary between initial skeleton and new growth in Coral 9(5)/6, Mount AB, Spine 0A.

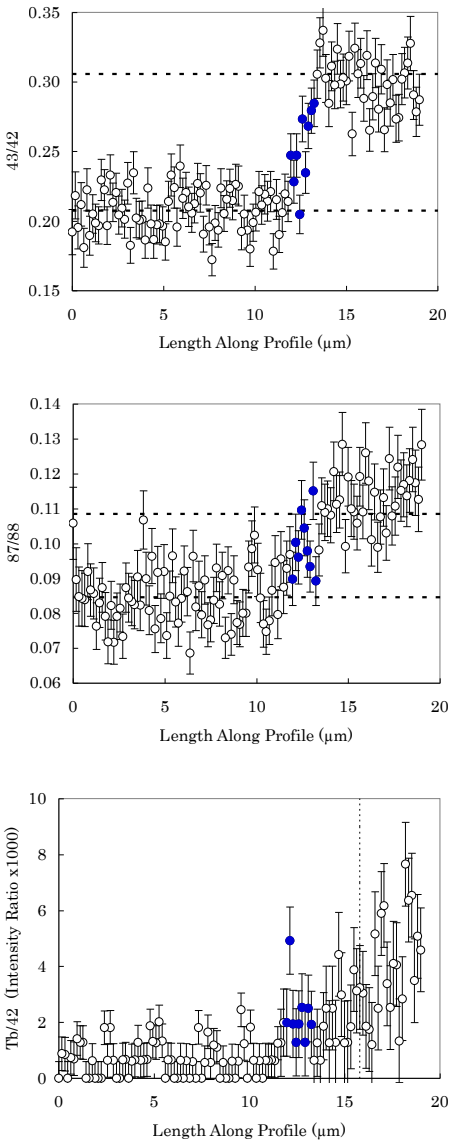

Figure 7: Profiles of the enriched isotopes ^{43}Ca, ^{87}Sr and ^{159}Tb across the new growth boundary in Coral 9(5)/6, Mount AB, Spine 0A (the previous image). Tb/42Ca appears to pass through three values: low Tb, high Tb and higher Tb (closer to edge). A vertical dashed line in the Tb/42Ca plot marks the predicted REE spike addition (where Tb was doubled at approx. 50 hours into the experiment). This predicted location was calculated assuming linear growth between the calcein mark and the outer edge of the skeleton over the 133 hour experiment. The transition between high Tb and higher Tb is near the expected location of the mid-experiment REE spike, supporting both our age model and the ability to resolve differences in Tb in this image. Unlike most other profiles, 87/88 in this profile is higher than the culture solution ratio. while it is easy to imagine processes that result in 87/88 lower than the culture solution (like a constant mixing rate with a very slow turn-over internal pool), processes that yield 87/88 higher than the culture media are hard to imagine. Therefore a process like instrumental mass fractionation drift or bias may be responsible for the small differences in isotope ratio between the NanoSIMS results and the culture media. The 16%–84% width of the boundary in the 42/43 profile is 1.2 μm. This is an expanded view of Figure 6 from the main text.

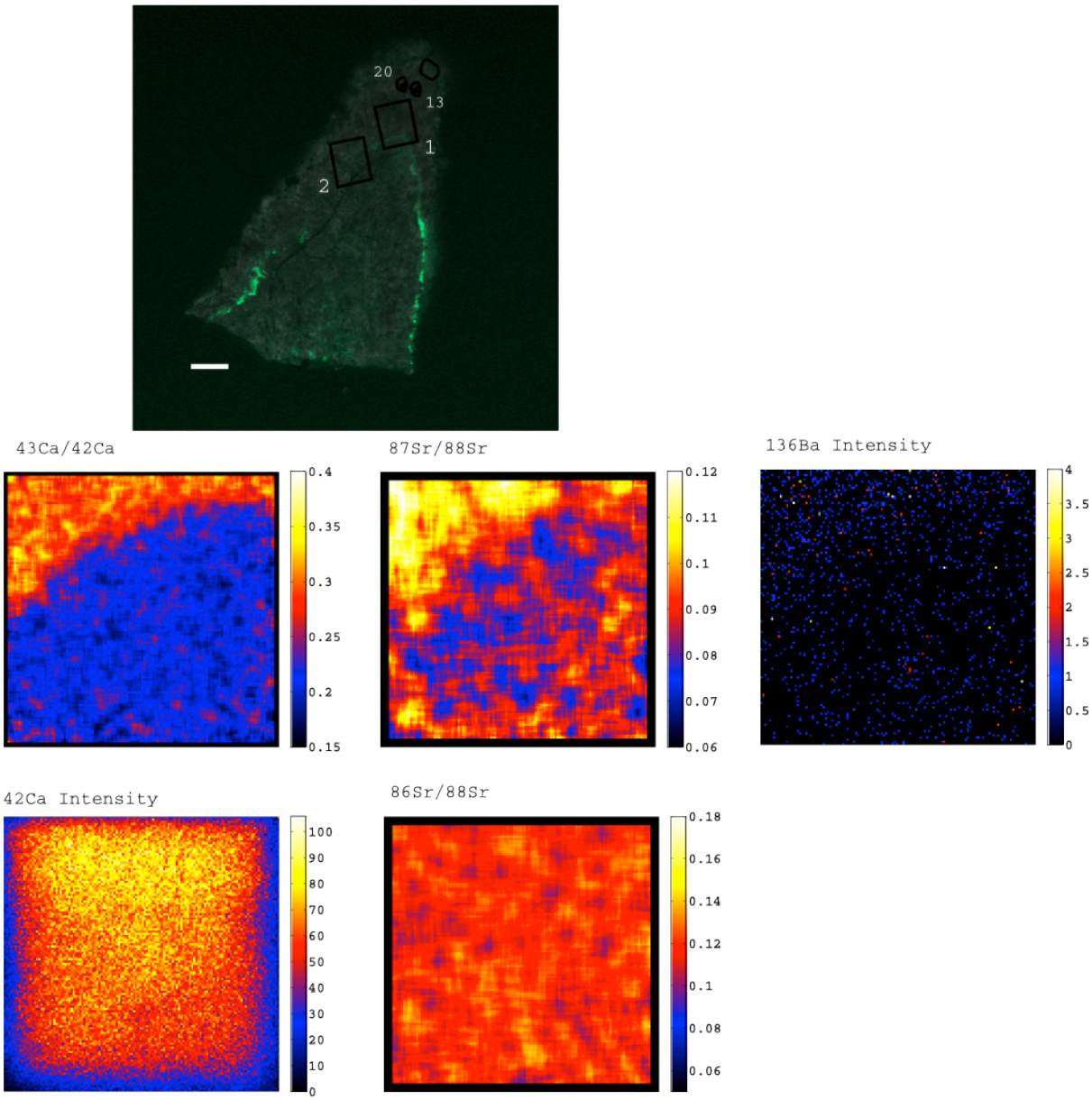

Figure 8: NanoSIMS ion image of the boundary between initial skeleton and new growth. Ion image corresponds to box 2 in the top image. Other boxes and spots correspond to other images and spots for other studies. Coral 2/5, Mount AA, Spine 1, Image 2.

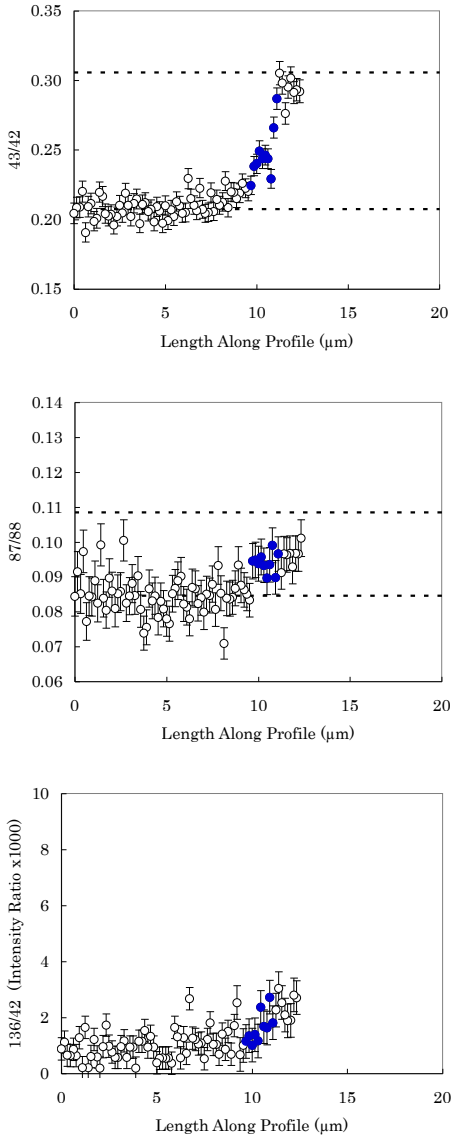

Figure 9: Profiles of the enriched isotopes ^{43}Ca, ^{87}Sr and ^{136}Ba across the new growth boundary of Coral 2/5, Mount AA, Spine 1, Image 2 (the previous image). Synchronous with calcium, ^{136}Ba rises above a basal level. The 87/88 ratio does not reach the culture ratio but is distinct from the pre-experiment level, again this may be a reflection of inaccurate correction for instrumental mass fractionation. Inspection of the ion images, clearly shows that that there is a distinct difference between initial skeleton and the region of new growth for 87/88. Due to geometrical limitations ion counting detectors can be positioned to either collect 88Sr and 136Ba or alternatively Tb, but not both. In this and the following image, ^{88}Sr and ^{136}Ba were collected. The 16%–84% width of the boundary in the 42/43 profile is 1.3 μm.

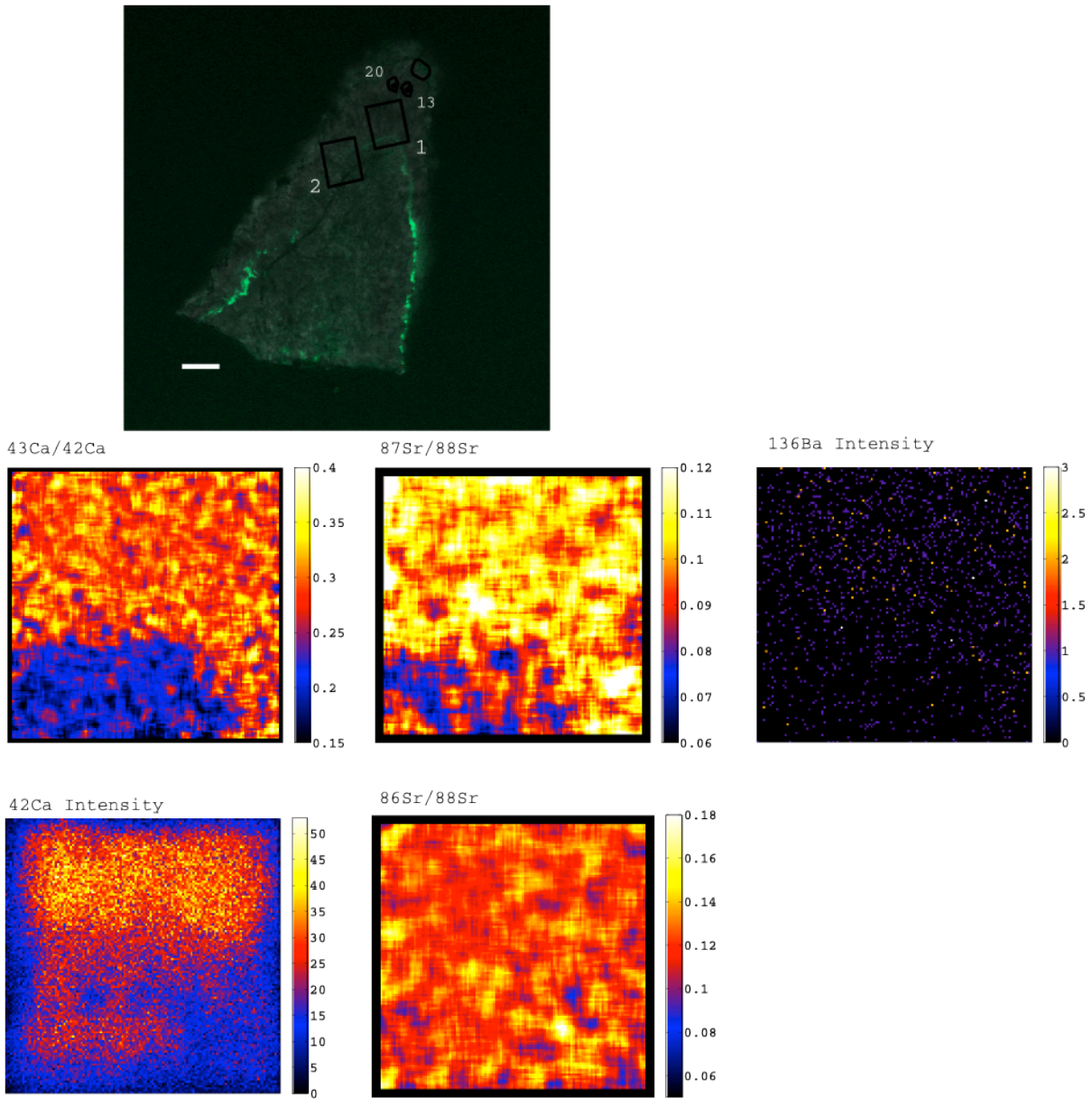

Figure 10: NanoSIMS ion image of the boundary between initial skeleton and new growth. Ion image corresponds to box 1 in the top image.The 42Ca intensity image for this region is less homogenous than most images, a result of the duo source cutting out during pre-sputtering. Pre-sputtering was re-started after fixing the source but the top of image received more pre-sputter ions than rest of image. Coral 2/5, Mount AA, Spine 1, Image 1.

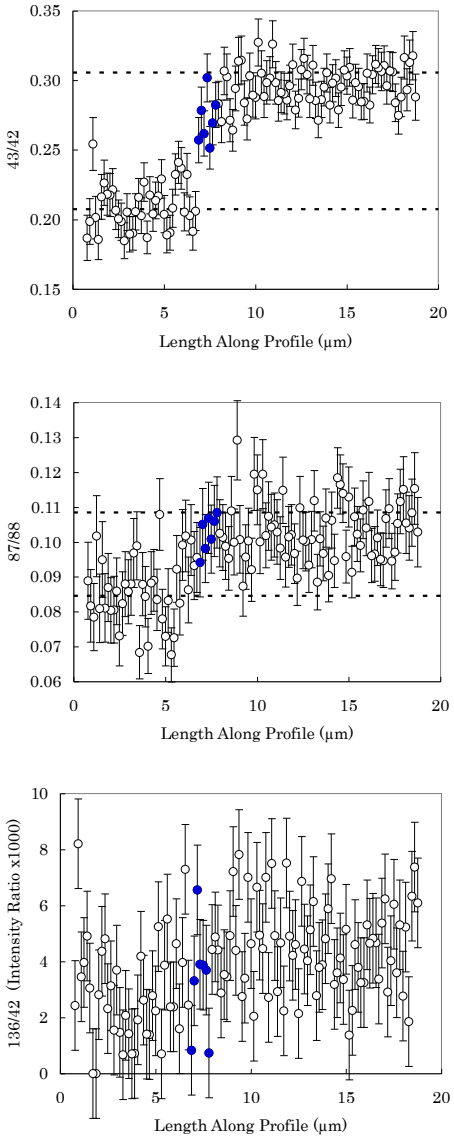

Figure 11: Profiles of the enriched isotopes ^{43}Ca, ^{87}Sr and ^{136}Ba across the new growth boundary of Coral 2/5, Mount AA, Spine 1, Image 1 (the previous image). Low sensitivity makes the barium isotope difficult to interpret, however, ^{136}Ba does appear to rises above a basal level synchronous with the calcium signal. The 16%–84% width of the boundary in the 42/43 profile is 0.9 μm.